On parasite in the RFQ

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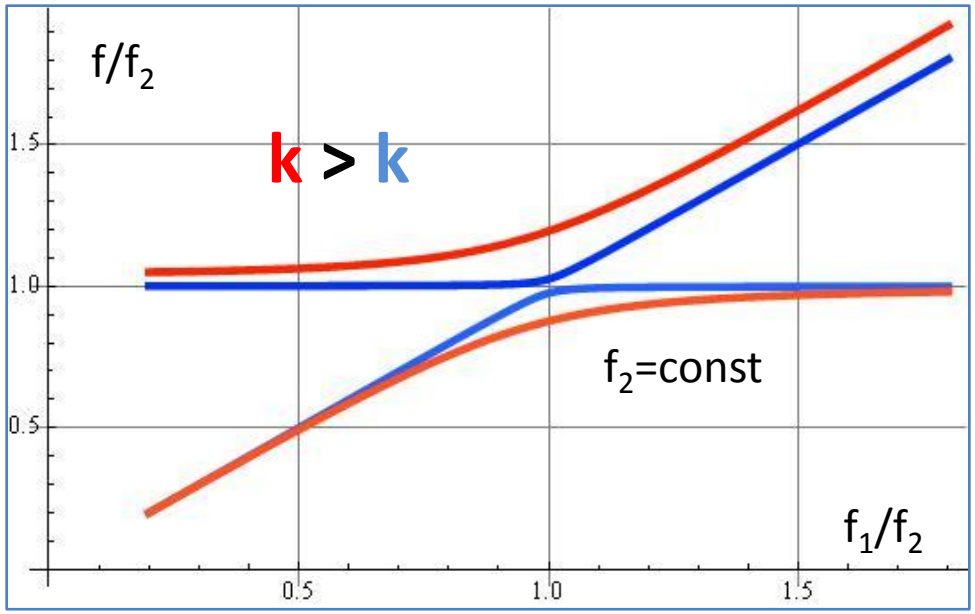
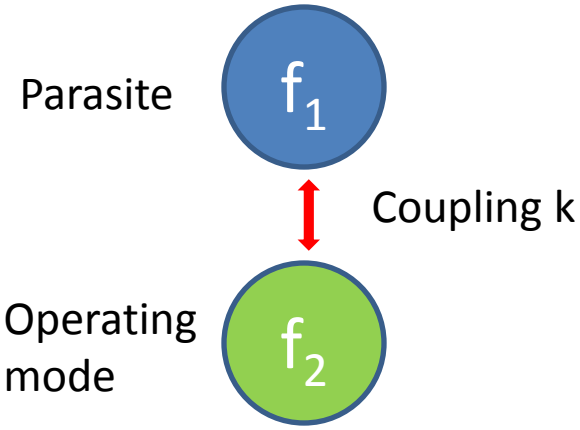
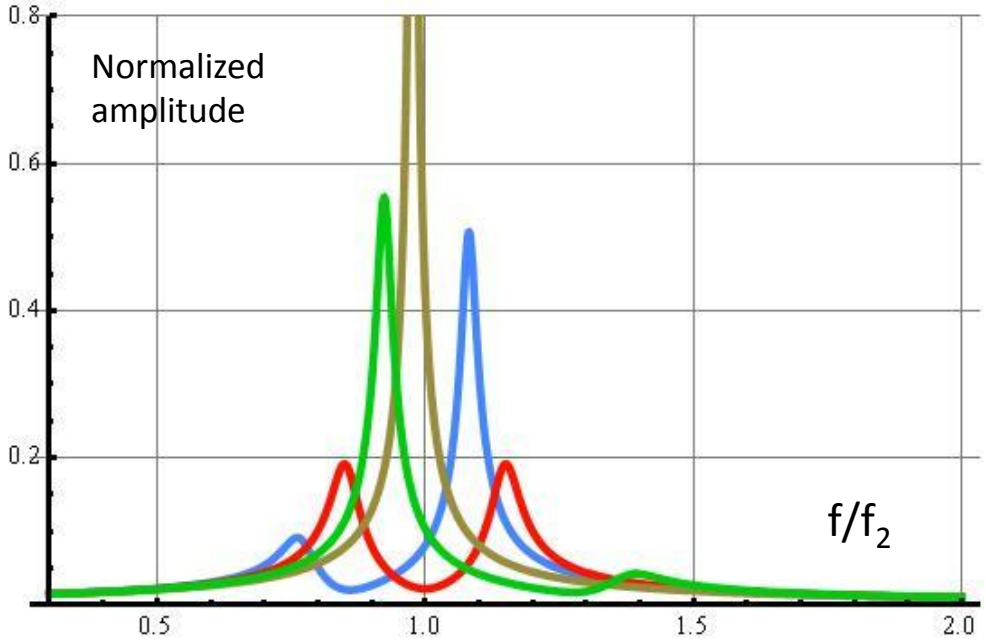
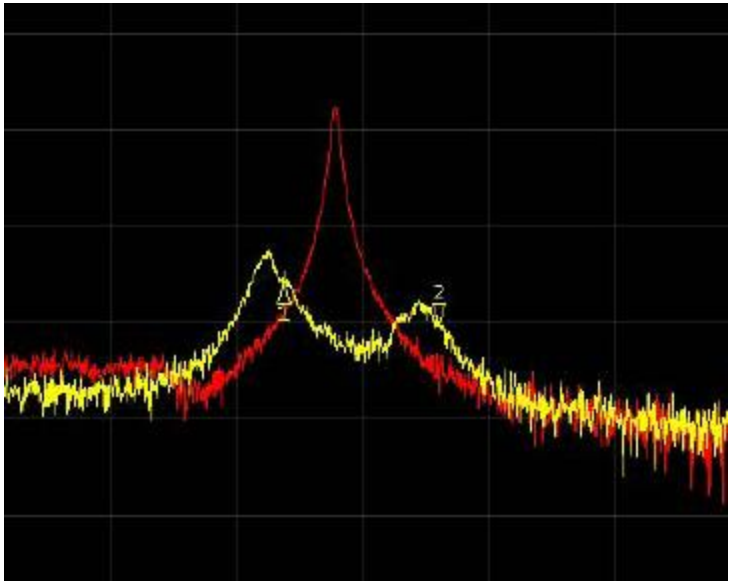
- There is a parasitic mode crossing RFQ's natural modes.
- It changes its frequency approximately by 5 MHz.
- Operating frequency decreases by 500 kHz.
- Number of couplers doesn't matter for the operating frequency decay if average power is kept constant.
- Manipulations with water cooling do not matter.
- Inlet and outlet water temperatures are almost constant.
- Nevertheless it's a heating problem without doubt.
- Change in field distribution is a result of mode mixing, not a primary problem.
- Trips at the end of decay are because of couplers (Dave's opinion).
- Simulation of RFQ with all features installed didn't show any signs of parasites inside RFQ (Andrey)



Mode mixing explains frequency decay

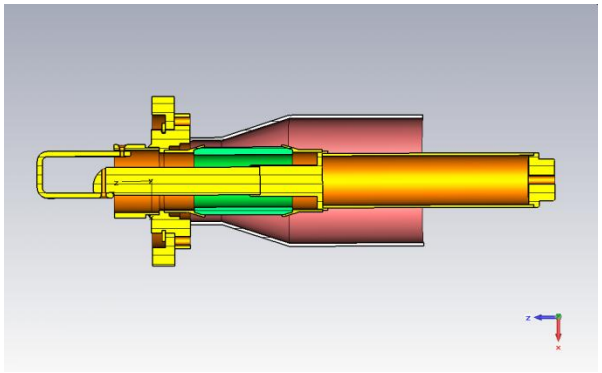


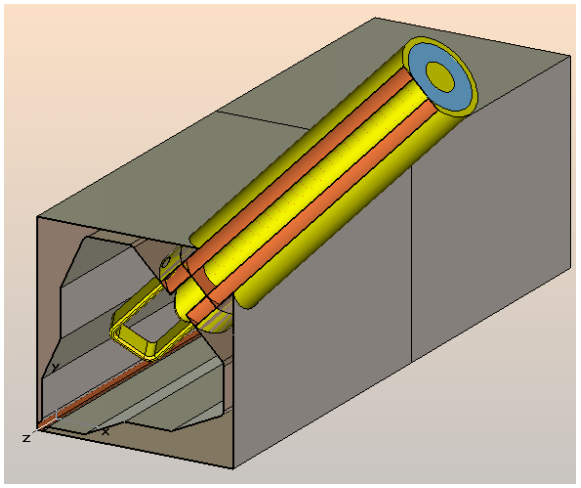


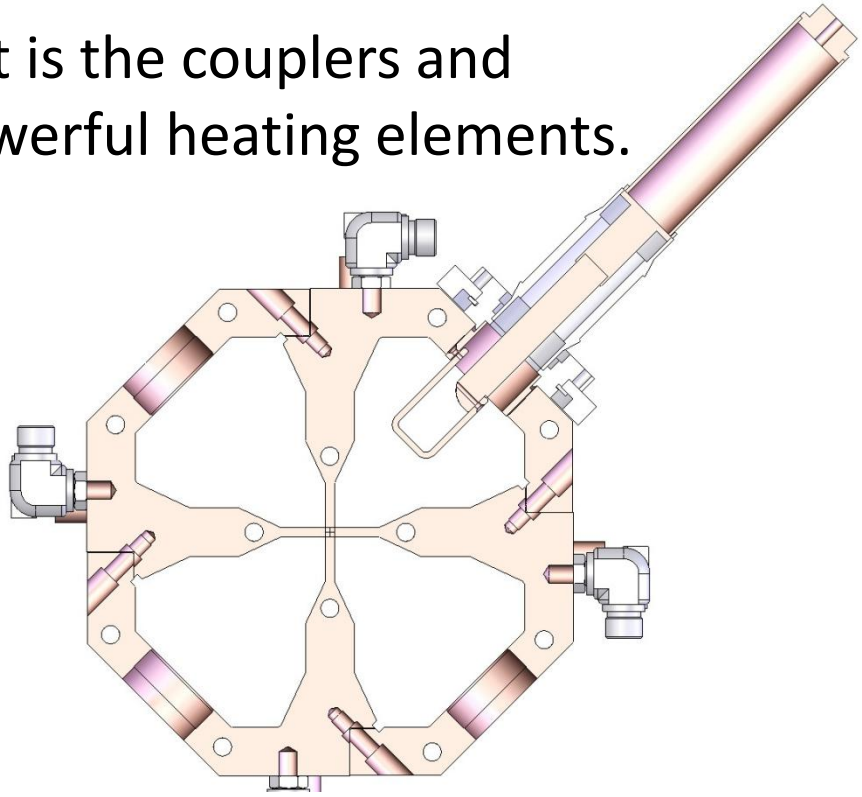


Suppose it’s a mode mixing with parasite. Two questions: where it comes from and how its big frequency excursion is possible?

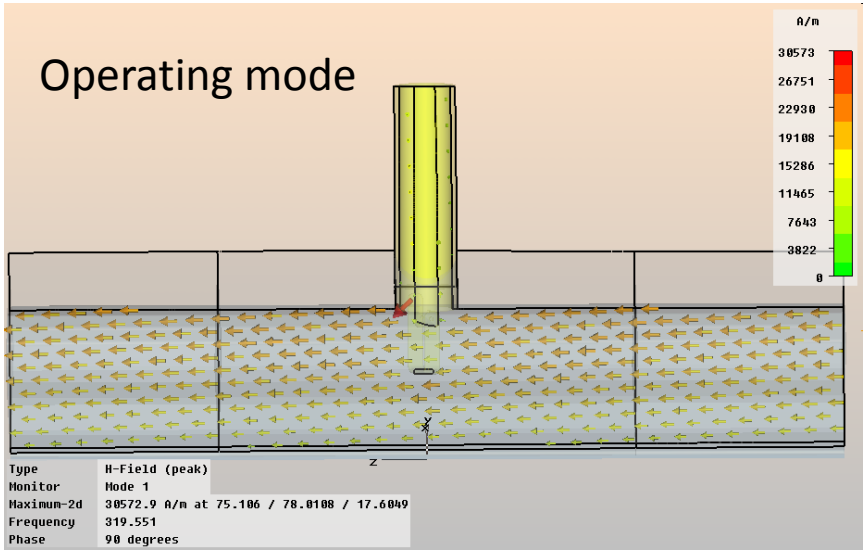
The only place we can think about is the couplers and beyond. Besides the loops are powerful heating elements.



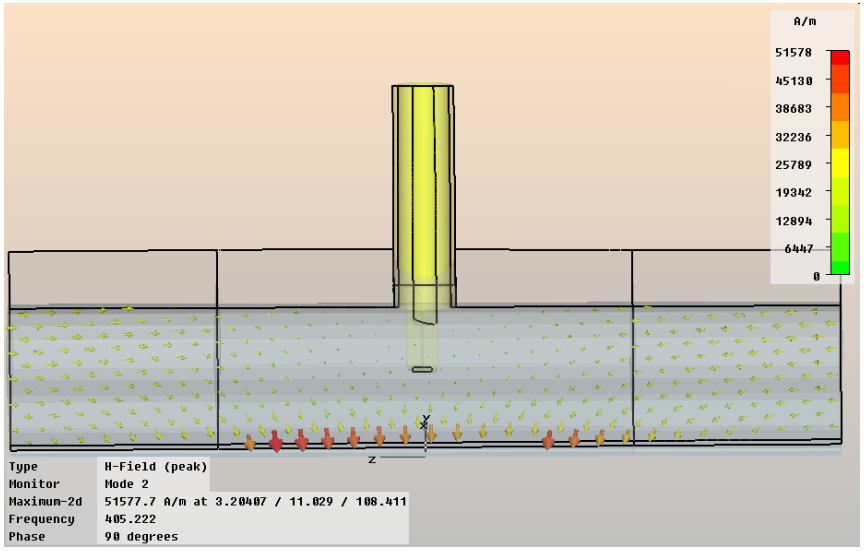




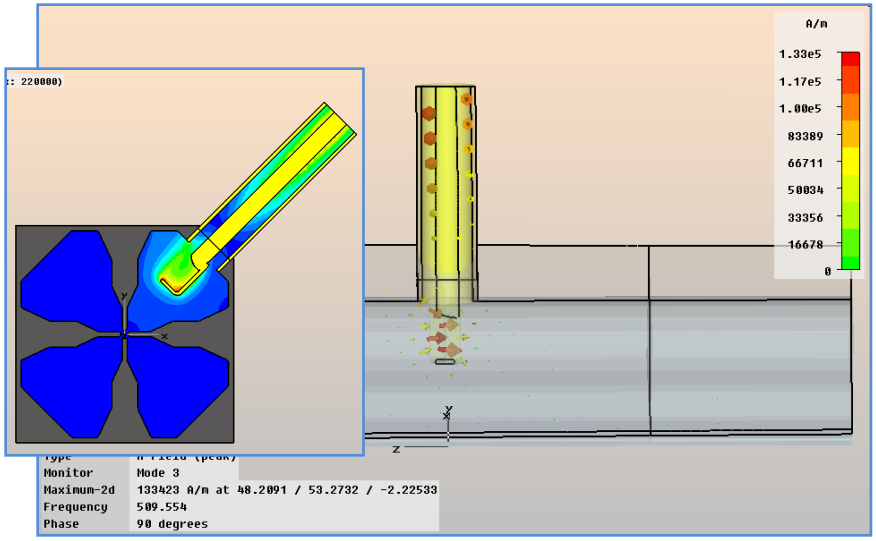
A model used to study a problem



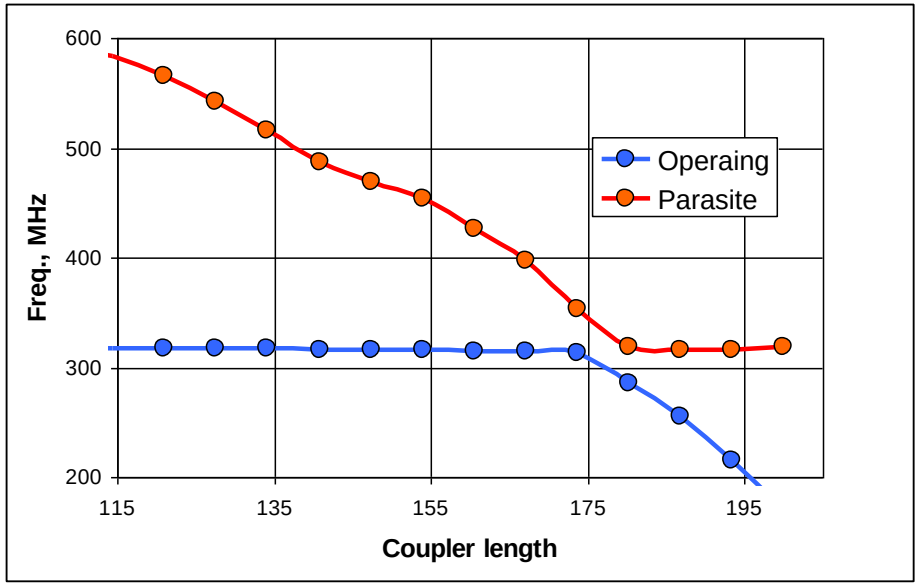
The waveguide system may contain a trapped mode (modes). Just assume that at least one of them exist. We can change its frequency changing the length of the coupler.

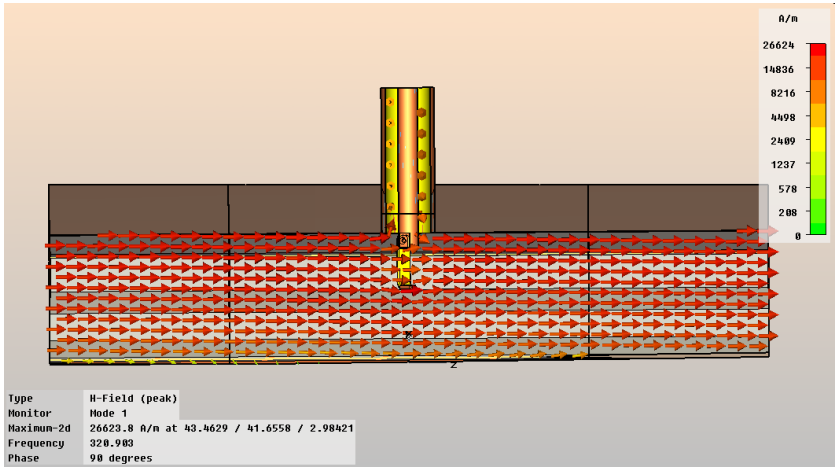


First harmonic of quadrupole mode.
Normally cannot be coupled with parasite

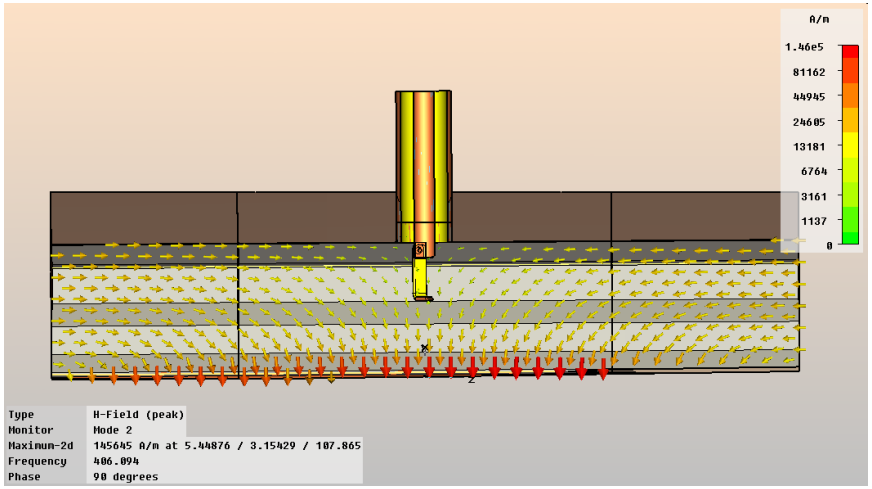


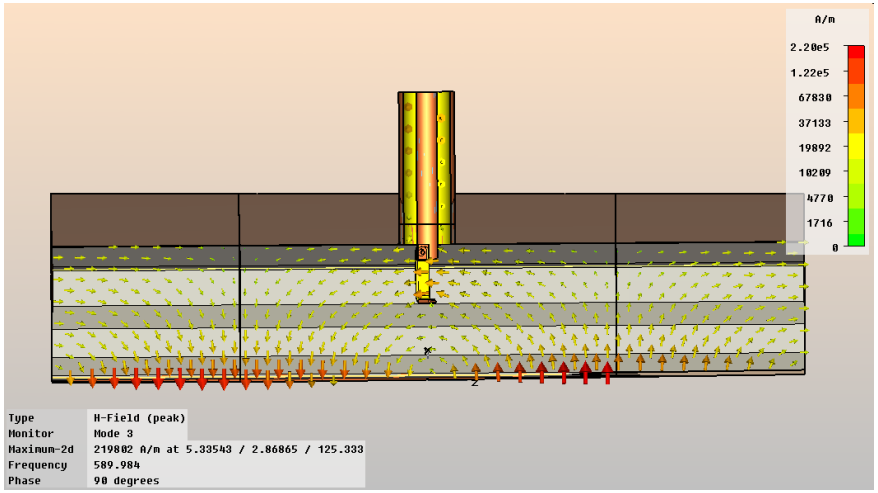
Parasite alone. If it's not mixed with RFQ mode, we hardly can see it with pick ups.



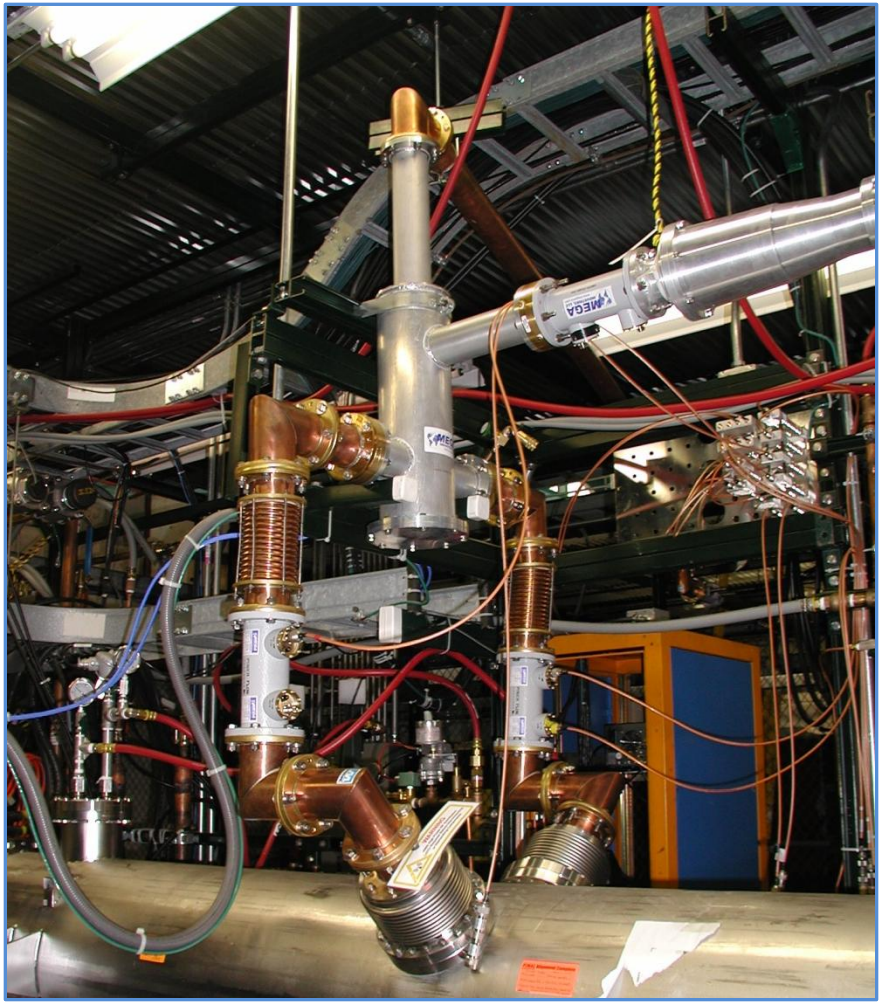


Operating mode and second harmonic can be coupled to parasite





First harmonic is not – no field in the coupler



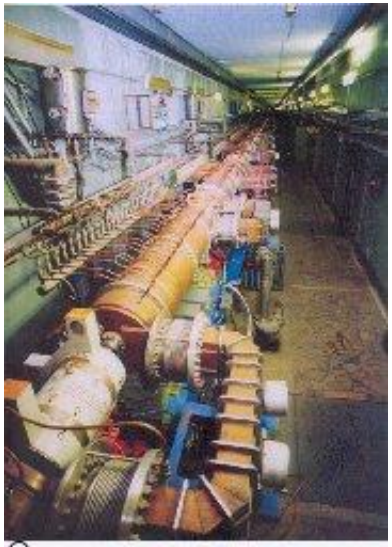
Parasitic mode starts at loop tip and ends… Where?

Coaxial waveguide with length 1680 mm has 357 MHz mode closest to operating one. Suppose its 330. Sensitivity is 0.24 MHz/mm. For 5 MHz we need 20 mm of thermal expansion. It means 730°C.

Shorter (920 mm) waveguide is more sensitive: 2.7 MHz/mm. For 5 MHz we need ≈2 mm of thermal expansion, which means 130°C.

Solution will depend on what mode we find. Probable scenarios:

- Change the lengths of waveguides
- New water cooled coupler identical by shape to existing to avoid re-tuning.
- Completely new water cooled coupler with loop reduced to normal size.



Основная часть ускорителя. Длина 360 м